

FORM PTO-1390 (Modified)
(REV 10-95)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

93195-000082

09/202107

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

N/A 09/202106

INTERNATIONAL APPLICATION NO.

PCT/JP98/01804

INTERNATIONAL FILING DATE

April 21, 1998

PRIORITY DATE CLAIMED

April 21, 1997

TITLE OF INVENTION

LIQUID CRYSTAL DISPLAY DEVICE, METHOD OF MANUFACTURING THE SAME AND ELECTRONIC EQUIPMENT

APPLICANT(S) FOR DO/EO/US

Eiji MURAMATSU; Shigetoshi YAMADA; Minoru IKEGAMI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
1. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371 (c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☐ Certificate of Mailing by Express Mail
19. ☒ Other items or information:

English translation of International Search Report; Form PTO-1449 and copies of References cited therein; Ten (10) pages of Drawings.

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR N/A	INTERNATIONAL APPLICATION NO. PCT/JP98/01804	ATTORNEY'S DOCKET NUMBER 9319S-000082
---	---	--

20. The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

- ☒ Search Report has been prepared by the EPO or JPO \$840.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) \$670.00
- ☐ No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$760.00
- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$970.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$96.00

CALCULATIONS PTO USE ONLY

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$840.00

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)). ☐ 20 ☐ 30

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	20 - 20 =	0	x \$18.00	\$0.00
Independent claims	5 - 3 =	2	x \$78.00	\$156.00
Multiple Dependent Claims (check if applicable).				<input type="checkbox"/> \$0.00

TOTAL OF ABOVE CALCULATIONS =

\$996.00

Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable). ☐

\$0.00

SUBTOTAL =

\$996.00

Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)). ☐ 20 ☐ 30 +

\$0.00

TOTAL NATIONAL FEE =

\$996.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). ☐

\$0.00

TOTAL FEES ENCLOSED =

\$996.00

Amount to be: refunded	\$
charged	\$

- ☒ A check in the amount of \$996.00 to cover the above fees is enclosed.
- ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.
- ☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 08-0750 A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

G. Gregory Schivley, Esq.
HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, MI 48303

SIGNATURE

G. Gregory Schivley

NAME

27,382

REGISTRATION NUMBER

DATE

Dec 18, 1998

Figure 1. The structure of the proposed model.

5 5

Applicants: Eiji MURAMATSU et al
International Application No.: PCT/JP98/01804
International Filing Date: 21 April 1998
For: **LIQUID CRYSTAL DISPLAY DEVICE,
METHOD OF MANUFACTURING THE
SAME AND ELECTRONIC EQUIPMENT**

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on Dec 18, 1998.

By

Sir:

Prior to the examination of this application, please amend it as follows:

IN THE SPECIFICATION

Please Amend the specification as follows:

Page 1, line 16, please delete "to" and substitute --as-- therefor.

Page 2, line 14, after "of", please insert --a--.

Page 4, line 8, please delete the first occurrence of "to" and substitute --on-- therefor.

Page 4, line 22, please delete "that".

Page 4, line 24, please delete the second occurrence of ",".

Page 5, line 6, please delete the first occurrence of "to" and substitute --on-- therefor.

Page 6, line 4, please delete "An" and substitute --A-- therefor.

Claim 12, line 6, please delete "the" and insert --an-- therefor.

Please add the following new claims:

--13. (NEW) A liquid crystal display device comprising:

a first substrate;

a second substrate opposite said first substrate;

a liquid crystal disposed between said first and second substrates; and

a resistance element having an adjustable resistance value disposed on one of said first and second substrates and coupled to said liquid crystal for changing a voltage imposed thereon.--

--14. (NEW) The liquid crystal display device of Claim 13 further comprising:

a liquid crystal driving integrated circuit mounted on said one of said first and second substrates having said resistance element disposed thereon.--

--15. (NEW) The liquid crystal display device of Claim 13 further comprising:

a plurality of electrodes formed on said first and second substrates, said electrodes being formed of the same material as said resistance element.--

--16. (NEW) The liquid crystal display device of Claim 13 wherein said adjustable resistance value of said resistance element is controlled by a pattern of said resistance element.--

--17. (NEW) The liquid crystal display device of Claim 13 further comprising a seal formed between said first and second substrates.--

--18. (NEW) The liquid crystal display device of Claim 17 further comprising a peripheral circuit disposed between said first and second substrates overboard of said seal.--

--19. (NEW) The liquid crystal display device of Claim 18 further comprising a second seal formed between said first and second substrates outboard of said peripheral circuit.--

--20. (NEW) The liquid crystal display device of Claim 18 wherein said peripheral circuit includes at least one of a resistance element and a capacitor.--

REMARKS

The purpose of this preliminary amendment is to clarify the specification as originally filed, to remove multiple dependant claims to reduce filing costs, and to add additional claims to provide Applicants with a scope of protection commensurate with their contribution to the art.

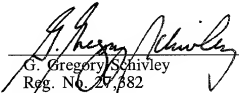
Favorable consideration of this application is respectfully requested.

Respectfully submitted,

Date: December 18, 1998

Harness, Dickey & Pierce, P.L.C.
P.O. Box 828
Bloomfield Hills, MI 48303
(248) 641-1600

By: _____


G. Gregory Schivley
Reg. No. 27,382
Bryant E. Wade
Reg. No. 40,344
Attorneys for Applicants

GGs/BEW/dr

10/ppts

63 Rec'd PCT/PTO 18 DEC 1998

09/202107

- 1 -

DESCRIPTION

LIQUID CRYSTAL DISPLAY DEVICE, METHOD OF MANUFACTURING THE SAME AND ELECTRONIC EQUIPMENT

TECHNICAL FIELD

The present invention relates to a liquid crystal display device for displaying a visible image such as a character, a numeral and the like by modulating light by controlling the alignment of a liquid crystal. Further, the present invention relates to a method of manufacturing the liquid crystal display device. In addition, the present invention relates to electronic equipment using the liquid crystal display device.

BACKGROUND ART

Recently, liquid crystal display devices have been widely used to a visible image displaying portion of various types of electronic equipment such as a video camera and the like. The liquid crystal display device modulates light by controlling the alignment of a liquid crystal depending upon whether a prescribed voltage is imposed thereon or not to thereby display a visible image such a character, a numeral and the like.

09202107-030899

2025

In an ordinary liquid crystal display device, a liquid crystal driving IC is mounted on a liquid crystal panel and when an output voltage of host equipment side, for example, a portable telephone, is imposed on the external input terminal of the liquid crystal driving IC, a voltage which will be imposed on a liquid crystal appears to the output terminal of the liquid crystal driving IC. However, the characteristics of liquid crystal driving ICs may be dispersed depending upon conditions under which they are manufactured and the characteristics of liquid crystal panels may be also dispersed. The following two methods are contemplated to impose an optimum voltage on each of the liquid crystals forming respective pixels even if such dispersion arises.

Conventionally, when a voltage is not adjusted on a host equipment side but adjusted on a liquid crystal display device side, an FPC (flexible printed circuit) or a transit PCB (printed circuit board) is connected to the external connecting terminal of a liquid crystal panel and a

resistance element is mounted on the FPC or the transit PCB and an operating voltage which will be supplied to a liquid crystal driving IC is changed by the action of the resistance element.

However, the conventional liquid crystal display device having the resistance element mounted on the FPC or the transit PCB has a problem that an additional area or space is required to the FPC or the like to mount the resistance element thereon and, as a result, the liquid crystal display device is increased in size accordingly.

In particular, when there is taken into consideration a liquid crystal display device of a type having a liquid crystal driving IC(s) directly mounted on one or both of a pair of light transmitting substrates having a liquid crystal sandwiched therebetween, that is, a liquid crystal display device of a COG (chip on glass) system, the liquid crystal display device has a great advantage that it does not especially require a large FPC, transit PCB and the like because the liquid crystal display device equips the liquid crystal driving IC(s) on the transparent substrate(s). Therefore, concerning the liquid crystal display device of the COG type, in case that the FPC or the transit PCB is additionally mounted on the liquid crystal display device wittingly in order to add a resistance element,, the advantage of the liquid crystal display device is greatly

reduced by it.

Incidentally, what is additionally connected to the liquid crystal driving IC is not limited to the resistance element and there is a case that a peripheral circuit including a resistance element, a capacitor and the like is disposed to the liquid crystal driving IC to assist the operation thereof. The capacitor is provided because of the following two reasons.

(1) Voltages imposed on respective liquid crystals corresponding to respective pixels in a liquid crystal panel appear to the output terminals of a liquid crystal driving IC. In the ordinary liquid crystal display devices, in order to impose desired voltages on only the liquid crystals of desired pixels and not to impose a voltage on the liquid crystals of the pixels disposed around the above pixels, it is insufficient only to impose a single pulse voltage on a scanning electrode and a signal electrode, and multi-stage pulse voltages must be properly superimposed and imposed thereon. To impose the multi-stage pulse voltages on the respective pixels as described above, the multi-stage pulse voltages must be individually output to the output terminals of the liquid crystal driving IC. In this case, if the respective pulse voltages are unstable, there is a possibility that noise arises and the quality of display of the liquid crystal display device is adversely affected by

the noise. To solve this problem, capacitors are connected in parallel between respective voltage levels from which the multi-stage pulse voltage outputs are originated.

(2) An general liquid crystal driving IC needs $V_{DD} = +3V$ to drive a logic system circuit and $V_{SS} = GND$ for grounding and further $V_{LCD} = -6V$ to drive a liquid crystal display device. Depending upon a type of the liquid crystal driving IC, there is a liquid crystal driving IC provided with three input terminals separately for the three potentials or a liquid crystal driving IC of a system which is provided with only input terminals corresponding to $V_{SS} = GND$ and $V_{DD} = +3V$ and creates $V_{LCD} = -6V$ in the interior thereof. When the liquid crystal driving IC of the system for creating V_{CLD} from V_{SS} and V_{DD} is used, a voltage increasing circuit including a capacitor must be additionally provided as a peripheral circuit around the liquid crystal driving IC.

Conventionally, when a peripheral circuit including a resistance element and a capacitor is additionally provided with a liquid crystal driving IC, the FPC or a transit PBC is connected to a liquid crystal panel and the peripheral circuit is amounted on the transit PCB or the like. Further, Japanese Laid-open No. 8-43845 and Japanese Laid-Open No. 8-43846 disclose a technology for directly mounting a capacitor on a substrate of a liquid crystal display device.

However, when the peripheral circuit is mounted on the transit PCB or the like, the area of the transit PCB or the like must be increased accordingly and further a large space must be prepared. Thus, there is a problem that the overall dimension of the liquid crystal display device is increased. In addition, a job for assembling the peripheral circuit on the transit PCB or the like is troublesome.

Further, when the peripheral circuit is directly mounted on the substrate of the liquid crystal display device as disclosed in Japanese Laid-open No. 8-43845 and the like, since the area of the projecting portion of the substrate must be increased accordingly, there is also a problem that the overall dimension of the liquid crystal display device is increased.

An object of the present invention made in view of the above problems arisen when a resistance element is additionally connected to a liquid crystal driving IC and also the above problem arisen when a peripheral circuit including a capacitor and the like is additionally connected to a liquid crystal driving IC. It is the object of the present invention to maintain a small overall dimension of a liquid crystal display device even if a resistance element is additionally connected to a liquid crystal driving IC or even if a peripheral circuit including a capacitor and the like is additionally connected to the liquid crystal driving

IC.

DISCLOSURE OF THE INVENTION

(1) To achieve the above object, a liquid crystal display device according to the present invention for displaying a visible image by controlling the alignment of a liquid crystal disposed between a pair of substrates by imposing a voltage on the liquid crystal is characterized in that a resistance element having an adjustable resistance value is disposed on at least one of the pair of substrates to change the voltage imposed on the liquid crystal.

According to the liquid crystal display device, even if a voltage supplied from host equipment to the liquid crystal display device is fixed to a given value, a voltage imposed on the liquid crystal in the liquid crystal display device can be adjusted to a prescribed value which is suitable to operate the liquid crystal with optimum contrast by adjusting the resistance value of the resistance element disposed on the substrate. Further, since the resistance element is directly mounted on the substrate, an FPC or a transit PCB need not be used, whereby an increase of the overall dimension of the liquid crystal display device can be avoided.

The liquid crystal display device is embodied in various types such as a TAB system, a COG system and the

Figure 6

Figure 6

Figure 1

limited to a resistance element having a specific structure and, for example, a resistor capable of changing a resistance value by moving a slide contact between a plurality of fixed contacts, that is, a so-called potentiometer can be used. In addition, since electrodes are generally formed on substrates by ITO (indium tin oxide), the resistance element can be also formed by the same ITO.

In this case, the ITO as the resistance element is previously set to a low resistance value and a proper portion thereof is partially removed as desired to thereby obtain a desired resistance value. The removal of the resistance element can be achieved by, for example, irradiating a laser beam to the resistance element. Since the simultaneous formation of the resistance element with the electrodes omits a process dedicated for the formation of the resistance element, a manufacturing cost can be suppressed to a low level.

(2) Next, a method of manufacturing a liquid crystal display device according to the present invention for displaying a visible image by controlling the alignment of a liquid crystal disposed between a pair of substrates by imposing a voltage on the liquid crystal is characterized by comprising the steps of mounting a resistance element having an adjustable resistance value on at least one of the pair of substrates and adjusting the voltage imposed on the

00202107-020899

liquid crystal to a prescribed value by adjusting the resistance value of the resistance element.

According to the manufacturing method, since an additional element such as the FPC or the like is not necessary when the resistance element is additionally connected, the overall dimension of the liquid crystal display device can be reduced.

(3) Next, a liquid crystal display device according to the present invention for displaying a visible image by controlling the alignment of a liquid crystal disposed between a pair of substrates is characterized in that a peripheral circuit is formed to a portion sandwiched between the pair of substrates.

According to the liquid crystal display device, since the peripheral circuit is formed to the region sandwiched between the pair of substrates making effective use of the region and the peripheral circuit is not formed to the projecting portion of the substrate, the area of the substrate can be made as small as possible. Further, an additional element such as the transit PCB or like is not necessary to assemble the peripheral circuit. As a result, the liquid crystal display device can be reduced in size. Since the peripheral circuit is formed simultaneously with a liquid crystal panel in a process for manufacturing the liquid crystal panel, a process for assembling the

peripheral circuit need not be separately executed after the completion of the liquid crystal panel, whereby a manufacturing cost can be reduced.

In an ordinary liquid crystal display device manufacturing process, a seal material is annularly formed to any one of a pair of substrates and one of the substrates is put on and bonded to the other substrate through the seal material. Since the thus formed liquid crystal display device has liquid crystal sealed into the inside region thereof surrounded by the seal member, when the present invention is applied to the thus arranged liquid crystal display device, it is preferable to dispose the peripheral circuit to a region outside of the seal material. With this arrangement, the liquid crystal is prevented from entering onto the peripheral circuit, whereby the stability of the peripheral circuit can be maintained.

In the aforesaid liquid crystal display device, the peripheral circuit can be surrounded by a second seal material. With this arrangement, the peripheral circuit can be prevented from being scratched by the bending of the substrate at a portion confronting the peripheral circuit.

The liquid crystal display device is embodied in the various types such as the TAB (Tape Automated bonding) system, the COG (chip on glass) system and the like as described above. The liquid crystal display device of the

09202107.030899

TAB system is such that a liquid crystal driving IC is mounted on a film carrier tape using the TAB technology and the film carrier tape is conductively connected to a liquid crystal panel using the connecting material such as the ACF (Anisotropic Conductive Film) and the like.

On the other hand, the liquid crystal display device of the COG system is such that a liquid crystal driving IC is directly mounted on at least one of a pair of light transmitting substrates having a liquid crystal disposed therebetween. When the peripheral circuit is formed between the pair of substrates as disclosed in the present invention, the area of the projecting portion of the substrate is not unnecessarily increased and further an additional element such as the transit PCB or the like need not be used, whereby a particular advantage can be obtained.

In the liquid crystal display device of the present invention, the peripheral circuit may be arranged as a circuit including a resistance element and/or a capacitor. The type of the peripheral circuit is not limited to a special type so long as the peripheral circuit can be formed on the substrate. When the resistance element is used as the peripheral circuit, the resistance element can be formed by a carbon printed resistor. When the capacitor is used as the peripheral circuit, a voltage output from the liquid crystal driving IC can be stabilized and the occurrence of

09202107, 030899

noise can be prevented. Further, a voltage having a new voltage value can be generated by increasing an external voltage imposed on the liquid crystal driving IC.

(4) Next, electronic equipment according to the present invention is electronic equipment including a liquid crystal display device according to the present invention. The electronic equipment includes at least the liquid crystal display device, a power supply for supplying power to the liquid crystal display device and a controller for controlling the operation of the liquid crystal display device. There can be contemplated, for example, a portable telephone, a video camera and other various types of electronic equipment as the electronic equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view showing an embodiment of a liquid crystal display device according to the present invention.

FIG. 2 is a perspective view showing a state after the embodiment shown in FIG. 1 is assembled.

FIG. 3 is a perspective view showing another embodiment of the liquid crystal display device according to the present invention.

FIG. 4 is a perspective view showing still another embodiment of the liquid crystal display device according to

00202107-0300000

the present invention and, in particular, a main portion thereof.

FIG. 5 is a plan view showing a further embodiment of the liquid crystal display device according to the present invention.

FIG. 6 is a plan view showing a main portion of the embodiment shown in FIG. 5 in an enlarged fashion.

FIG. 7 is a view showing an equivalent circuit when the structure shown in FIG. 6 is electrically shown.

FIG. 8 is a view of an example showing how a voltage is changed when the equivalent circuit of FIG. 7 is used.

FIG. 9 is an exploded perspective view showing a still further embodiment of the liquid crystal display device according to the present invention.

FIG. 10 is a perspective view showing a state after the embodiment shown in FIG. 9 is assembled.

FIG. 11 is an exploded perspective view of an embodiment of electronic equipment according to the present invention.

FIG. 12 is a block diagram of an electric control system used to the electronic equipment of FIG. 11.

BEST MODE OF CARRYING OUT THE INVENTION

(First Embodiment)

FIG. 1 shows an embodiment of a liquid crystal display

device according to the present invention. The liquid crystal display device is a liquid crystal display device of a passive matrix system in which an active element is not used and further a liquid crystal display device of a COG system in which a liquid crystal driving IC is directly mounted on a substrate.

The liquid crystal display device includes a transparent substrate 1a as a light transmitting substrate and another transparent substrate 1b which is paired with the transparent substrate 1a. These transparent substrates are formed of glass, plastic or the like. Stripe-shaped electrodes 2a and pattern electrodes 3a having special shapes are formed on the surface of one of the transparent substrates 1a by ITO (indium tin oxide). Further, stripe-shaped electrodes 2b and pattern electrodes 3b are formed on the surface of the confronting substrate 1b by ITO likewise.

A region A on which a liquid crystal driving IC 4 is mounted is formed to the objecting portion of one of the transparent substrates 1a and the plurality of electrodes 2a and 3a of the transparent substrate 1a directly extend up to the region A, respectively. On the other hand, the plurality of the electrodes 2b and 3b of the transparent substrate 1b extend up to the IC mounting region A through upper/lower conductors 6 disposed to the transparent substrate 1a, respectively.

External connecting terminals 7 are formed to the input terminals of the IC mounting region A by ITO to make conduction between them and an external circuit. Further, a resistance pattern 8 is formed by ITO to a position corresponding to the resistor connecting terminal of the liquid crystal driving IC 4. The resistance pattern 8 as an electric circuit lowers external voltages supplied from the external connecting terminals 7 in accordance with its resistance value and imposes the lowered voltages on the liquid crystal driving IC 4 as operation voltages. The external connecting terminals 7 and the resistance pattern 8 are formed simultaneously with the formation of the electrodes 2a, 3a on the transparent substrate 1a.

When the stripe-shaped electrodes 2a, the pattern-shaped electrodes 3a, the external connecting terminals 7 and the resistance pattern 8 are formed on one of the transparent substrates 1a and further the stripe-shaped electrodes 2b and the pattern-shaped electrodes 3b are formed on the other transparent substrate 1b, alignment films are further formed thereon and the respective transparent substrates are subjected to alignment processing, for example, lapping processing.

Thereafter, a seal material 9 is annularly formed on any one of the transparent substrates, for example, the transparent substrate 1a by screen printing and further

Subsequently, liquid crystal is charged into a space formed between the transparent substrate 1a and the transparent substrate 1b, that is, a so-called cell gap. Further, the liquid crystal driving IC 4 is bonded to the IC mounting position A of the transparent substrate 1a using an ACF (anisotropic conductive film) 11 to thereby conductively connect the bumps of the liquid crystal driving IC 4 to corresponding electrode terminals.

With above arrangement, a liquid crystal panel on which the liquid crystal driving IC 4 is mounted is formed. When external voltages each having a prescribed value are imposed on the external connecting terminals 7 and an output voltage obtained at the output terminal of the liquid crystal driving IC 4 is out of a prescribed voltage value set to the liquid crystal, any one of the resistance branches 8a of the resistance pattern 8 is cut off by a laser beam irradiated thereto to thereby adjust the voltage imposed on the liquid crystal in the liquid crystal panel to

a value proper to the liquid crystal. Since a plurality of the resistance branches 8a are disposed in parallel with each other positionally and in series to each other electrically, one or a plurality of them are cut off as necessary.

Thereafter, polarizers are bonded to the outside surfaces of the transparent substrates 1a, 1b to thereby complete a liquid crystal display device as shown in FIG. 2. In the liquid crystal display device, a back light unit is attached externally of the transparent substrate 1a or the transparent substrate 1b when necessary. In the liquid crystal display device of the embodiment, since a resistance element added to the outside of the liquid crystal driving IC 4 is not indirectly connected to the liquid crystal panel through an FPC or the like but it is directly formed on the transparent substrate 1a of the liquid crystal panel, the overall dimension of the liquid crystal display device is not uselessly increased.

(Second Embodiment)

FIG. 3 shows another embodiment of the liquid crystal display device according to the present invention. The embodiment is different from the previous embodiment shown in FIG. 2 in that a potentiometer 13 is used in place of the ITO resistance pattern 8 as a resistance element disposed on a transparent substrate 1a. As known well, the

potentiometer 13 is a resistance element capable of changing a resistance value between terminals by moving a slide contact between a plurality of fixed terminals by rotating a knob 14. In the embodiment, the potentiometer 13 is conductively connected to an electrode terminal on the transparent substrate 1a by soldering or other conductively connecting processing.

Although, in the liquid crystal display device of FIG. 2, the resistance value is adjusted by partly removing the resistance pattern 8 by the irradiation of the laser beam, the resistance value in the embodiment can be adjusted by rotating the knob 14 of the potentiometer 13 only a suitable angle. Since the potentiometer 13 is directly mounted on the transparent substrate 1a of a liquid crystal panel also in the embodiment, an indirect part such as an FPC or the like need not be used, whereby the overall dimension of the liquid crystal display device is not uselessly increased.

(Third Embodiment)

FIG. 4 is a perspective view showing still another embodiment of the liquid crystal display device according to the present invention and, in particular, a main portion thereof. In the embodiment, a resistance element is disposed on a transparent substrate 1a by a resistance pattern 18 formed by ITO likewise the embodiment shown in FIG. 2. However, the resistance pattern 18 used in the

(Fourth Embodiment)

FIG. 5 is a plan view showing a further embodiment of the liquid crystal display device according to the present invention. The embodiment is arranged similarly to the previous embodiment shown in FIG. 1 in that a transparent substrate 1a is jointed to a transparent substrate 1b by a seal material 9, polarizers 12 are bonded to the outside surfaces of the transparent substrates 1a, 1b, a liquid crystal driving IC 4 is mounted on the objecting portion of the transparent substrate 1a, an external connecting terminal 7 is formed to a side end of the transparent substrate 1a and a resistance pattern 28 is formed to the objecting portion of the transparent substrate 1a.

The embodiment is different from the embodiment shown in FIG. 1 in that the resistance pattern 28 is modified, which will be specifically described below. As shown in FIG. 6, the resistance pattern 28 includes five resistance branches 28a - 28e which are composed of the same material as that of the electrodes 2a, 3a (see FIG. 1) and formed simultaneously with them.

The resistance branch 28c is connected to the ground level of the liquid crystal driving IC 4, further the resistance branch 28c is connected to the resistance branch 28a through a narrow communication pattern S1, the ground resistance branch 28c is connected to the resistance branch 28b through a narrow communication pattern S2, the ground resistance branch 28c is connected to the resistance branch 28d through a narrow communication pattern S3 and the ground resistance branch 28c is connected to the resistance branch 28e through a narrow communication pattern S4.

The respective communication patterns S1 - S4 act as switching elements for intermittently connecting the ground resistance branch 28c to the respective resistance branches 28a, 28b, 28d and 28e. FIG. 7 shows them in an electrical circuit. When the liquid crystal display device is initially manufactured, since the respective communication patterns S1 - S4 connect the resistance branches 28a - 28e to each other, the respective communication patterns S1 - S4

are turned on.

Since the respective resistance branches 28a - 28e are connected to a resistor disposed in the liquid crystal driving IC 4, when any one of the communication patterns S1 - S4 or a plurality of them combined suitably are selected and cut off, a suitable one or ones of the switches S1 - S4 in FIG. 7 can be turned off. The communication patterns S1 - S4 can be cut off by the irradiation of, for example, a laser beam.

When a suitable one or ones of the communication patterns S1 - S4 are selected and cut off, that is, when they are turned off, an operation voltage imposed on the liquid crystal driving IC 4 can be changed to a desired voltage value. For example, an operation voltage V_{op} can be changed to four stages of +2%, +1%, -1% and -2% as shown in FIG. 8.

That is, the embodiment does not change the respective resistance branches 28a - 28e so that they have target resistance values, but uses them as the switching elements and changes resistance values by controlling ON and OFF of the switching elements of them.

(Fifth Embodiment)

FIG. 9 shows a still further embodiment of the liquid crystal display device according to the present invention. In the embodiment, the same numerals as used in the

In the embodiment, external connecting terminals 7 are formed on the input terminal side of an IC mounting region A by ITO to make electrical communication with an external circuit. Further, resistance elements, for example, carbon printed resistors 40 are formed to the extreme ends of an ITO patterns 38 extending from a position corresponding to the resistor connecting terminal of a liquid crystal driving IC 4. The resistors 40 operates, as an electro-circuit, to imposes external voltages supplied from the external connecting terminals 7 on the liquid crystal driving IC 4 as operating voltages after dropping the external voltages in accordance with the resistance values thereof. The external connecting terminals 7 and the ITO patterns 38 are formed simultaneously with the formation of electrodes 2a, 3a on a transparent substrate 1a. The printed resistors 40 are formed at a suitable timing after or before the ITO patterns 38 are formed.

When the stripe-shaped electrodes 2a, the pattern-shaped electrodes 3a, the external connecting terminals 7, the ITO pattern 38 and the resistors 40 are formed on one of transparent substrates 1a and further stripe-shaped electrodes 2b and pattern-shaped electrodes 3b are formed on

Thereafter, a seal material 9 is annularly formed on one of the transparent substrates, for example, the transparent substrate 1a by screen printing in such a manner that the region where the resistors 40 are formed is located externally of the annular seal material 9 and further the periphery of the resistors 40 is surrounded by a second seal material 9a. Subsequently, spacers such as beads or the like are dispersed on the transparent substrate 1a and then the pair of transparent substrates 1a, 1b are superposed on each other so that the stripe-shaped electrodes 2a are perpendicular to the stripe-shaped electrodes 2b and they are joined to each other by the seal material 9 and the second seal material 9a.

Subsequently, liquid crystal is charged into a space formed between the transparent substrate 1a and the transparent substrate 1b, that is, to a so-called cell gap. At the time, the liquid crystal is not charged into the cell partitioned by the second seal material 9a which surrounds the resistors 40, although the liquid crystal is sealed in the inside region of the seal material 9. Next, the liquid crystal driving IC 4 is bonded to the IC mounting region A

of the transparent substrate 1a using an ACF 11 to thereby conductively connect the respective bumps of the liquid crystal driving IC 4 to corresponding electrode terminals on the transparent substrate 1a.

With above arrangement, a liquid crystal panel on which the liquid crystal driving IC 4 is mounted is formed and further a liquid crystal display device 35 as shown in FIG. 10 is completed by bonding polarizers to the outside surfaces of the transparent substrates 1a, 1b. In the liquid crystal display device 35, a back light unit is attached externally of the transparent substrate 1a or the transparent substrate 1b when necessary. In the liquid crystal display device 35 of the subject embodiment, since a voltage dividing circuit including the resistors 40 is provided as the peripheral circuit of the liquid crystal driving IC 4, even if an external voltage, which is supplied from external equipment, for example, a portable telephone, through the external connecting terminals 7, is fixed to a given value, the external voltage can be changed by the resistors 40. Therefore, proper operation voltages can be supplied to the liquid crystal driving IC 4 at all times, whereby proper switching voltages can be imposed on the respective pixel liquid crystals in the liquid crystal display device.

Moreover, in the subject embodiment, since the

peripheral circuit including the resistors 40 is disposed to the main body portion of the liquid crystal panel, that is, to a portion sandwiched between the pair of transparent substrates 1a, 1b, instead of being disposed on the objecting portion of the transparent substrate 1a, the size of the objecting portion of the transparent substrate 1a need not be increased. Further, it is not necessary to employ such a large and troublesome structure that a transit PCB is connected to the external connecting terminal 7 of the liquid crystal panel and resistance elements are assembled on the transit PCB. As a result, the overall dimension of the embodiment can be greatly reduced regardless of that the peripheral circuit is included in the liquid crystal display device.

(Modified Embodiment)

The voltage dividing circuit using the printed resistors 40 as the peripheral circuit is contemplated in the embodiment of FIG. 9. However, a peripheral circuit applicable thereto may include any arbitrary electronic elements other than the resistance elements, for example, capacitors. The employment of the peripheral circuit including the capacitors can stabilize the voltage output from the liquid crystal driving IC and generate a voltage having other value at internal of the liquid crystal drying IC, by utilizing a voltage input to the input terminal of

the liquid crystal driving IC. To form the capacitors in a narrow gap formed between the pair of transparent substrates, the electrodes of the confronting substrates can be connected to each other by upper/lower conductors likewise the stripe-shaped electrodes for driving the liquid crystal, although a dielectric may be or may not be sandwiched between confronting ITOs.

(Sixth Embodiment)

FIG. 11 shows an embodiment when the liquid crystal display device according to the present invention is used as a display unit of a portable telephone as electronic equipment. The portable telephone shown here comprises an upper case 26 and a lower case 27. The upper case 26 includes a transmitting/receiving antenna 30, a keyboard unit 29 and a microphone 32. The lower case 27 includes a liquid crystal display device 35 shown in, for example, FIG. 10, a speaker 33 and a circuit board 34.

As shown in FIG. 12, there are disposed on the circuit board 34 a receiving unit 31 connected to the input terminal of the speaker 33, a transmitting unit 37 connected to the output terminal of the microphone 32, a controller 36 composed of a CPU and the like and a power supply 39 for supplying power to the respective units. The controller 36 reads the states of the transmitting unit 37 and the receiving unit 31 and supplies information to a liquid

(Other Embodiments)

For example, as to the liquid crystal display device of the present invention, the present invention is also applicable to a liquid crystal display device of any arbitrary system, for example, a liquid crystal display device of a TAB system in addition to the liquid crystal display device of the COG system shown in FIG. 1 to FIG. 4. Although the respective embodiments employ the light transmitting (transparent) substrate, the substrate may be not transparent. Further, the present invention is also applicable to a liquid crystal display device of an active matrix type when necessary.

As to the electronic equipment of the present invention, although the embodiment shown in FIG. 11 exemplifies a case that the liquid crystal display device of the present invention is applied to the visible image display unit of the portable telephone, it is needless to say that the present invention is applicable to any arbitrary electronic equipment other than the portable telephone, for example, a finder of a video camera and the like.

Industrial Applicability

The liquid crystal display device of the present invention can be preferably used as a visible image display unit of electronic equipment such as a portable telephone, a video camera and the like. The method of manufacturing the liquid crystal display device according to the present invention can be preferably used to manufacture a liquid crystal display device of this type having a small overall dimension. Further, the electronic equipment according to the present invention is effective as various types of electronic equipment provided with a display unit for displaying visible images such as characters, numerals, pictures and the like.

CLAIMS

1. A liquid crystal display device for displaying a visible image by controlling the alignment of a liquid crystal disposed between a pair of substrates by imposing a voltage on the liquid crystal, wherein a resistance element having an adjustable resistance value is disposed on at least one of the pair of substrates to change the voltage imposed on the liquid crystal.

2. A liquid crystal display device according to claim 1, wherein a liquid crystal driving IC is directly mounted on at least one of the pair of substrates and said resistance element is disposed on the substrate on which said liquid crystal driving IC is mounted.

3. A liquid crystal display device according to claim 1 or claim 2, wherein said resistance element is composed of the same material as that of the electrodes formed on the substrates and formed to a prescribed pattern and the resistance value of said resistance element is set by partially removing the pattern shape by removal processing.

4. A liquid crystal display device according to claim 3, wherein said resistance element is formed by ITO (indium

5. A method of manufacturing a liquid crystal display device for displaying a visible image by controlling the alignment of a liquid crystal disposed between a pair of substrates by imposing a voltage on the liquid crystal, wherein the method is comprised of the following steps of:

adjusting the voltage imposed on the liquid crystal to a prescribed value by adjusting the resistance value of the resistance element.

7. A liquid crystal display device according to claim 6, wherein the pair of substrates are bonded to each other by a seal material and said peripheral circuit is disposed to the outside of the seal material.

8. A liquid crystal display device according to claim 6 or claim 7, wherein said peripheral circuit is disposed in a cell surrounded by a second seal material.

9. A liquid crystal display device according to claim 6, wherein a liquid crystal driving IC is disposed on at least one of the pair of substrates.

10. A liquid crystal display device according to claim 6, wherein said peripheral circuit includes a resistance element and/or a capacitor.

11. A liquid crystal display device according to claim 10, wherein the resistance element is a carbon printed resistor.

12. An electronic equipment including a liquid crystal display device, a power supply for supplying power to the liquid crystal display device and a controller for controlling the operation of the liquid crystal display device, wherein the liquid crystal display device displays a visible image by controlling the alignment of a liquid crystal disposed between a pair of substrates, and a peripheral circuit is formed to a portion sandwiched between the pair of substrates.

00202107-0300000

ABSTRACT

[illegible]

FIG. 1

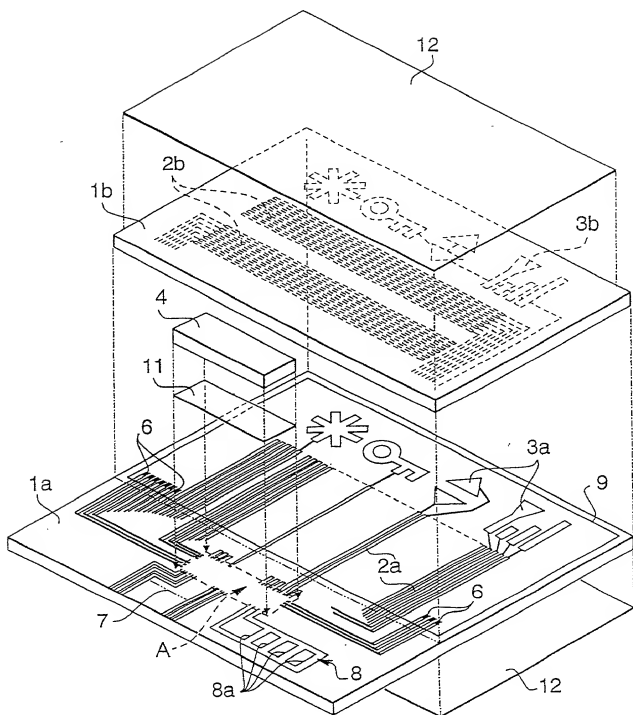
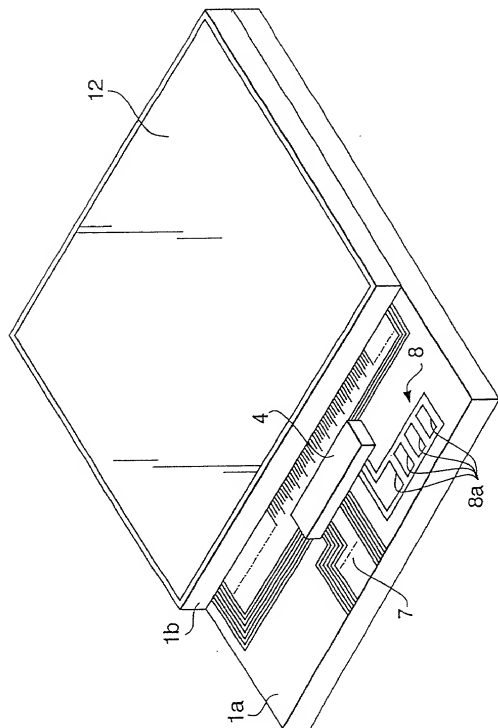
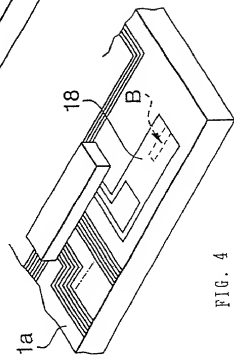
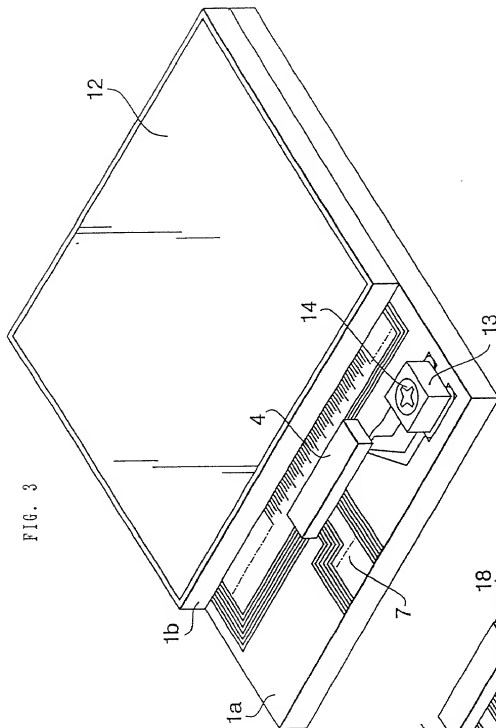


FIG. 2





4/10

FIG. 5

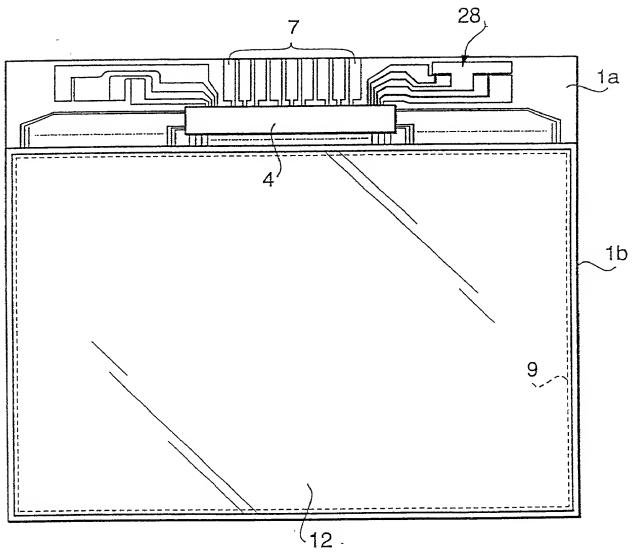
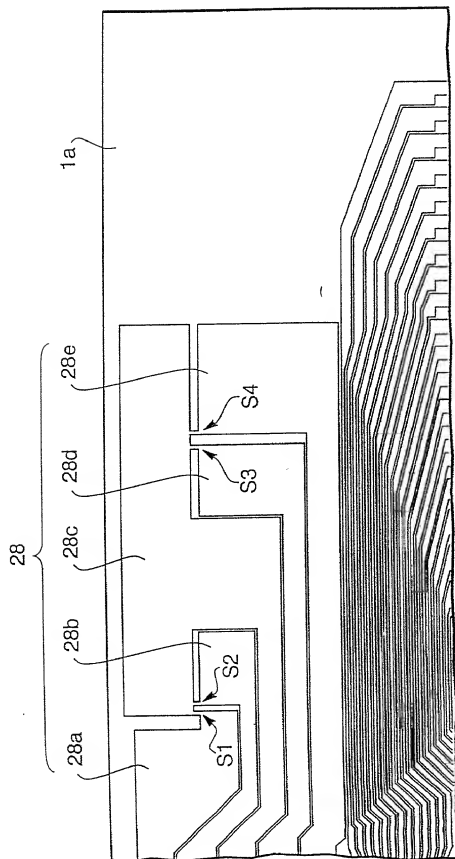


FIG. 6



6/10

FIG. 7

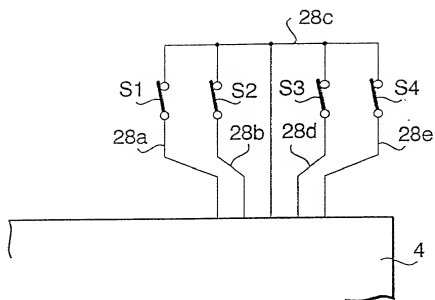


FIG. 8

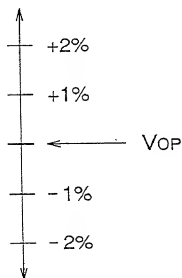


FIG. 9

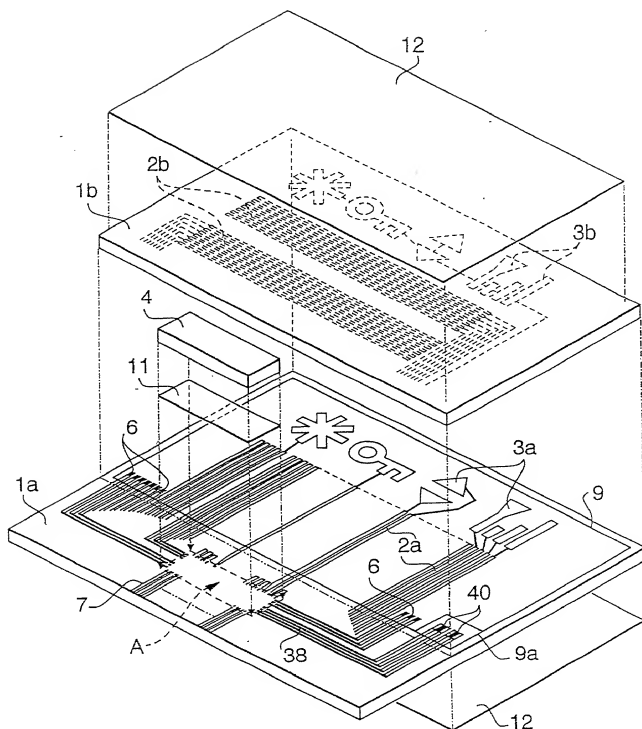


FIG. 10

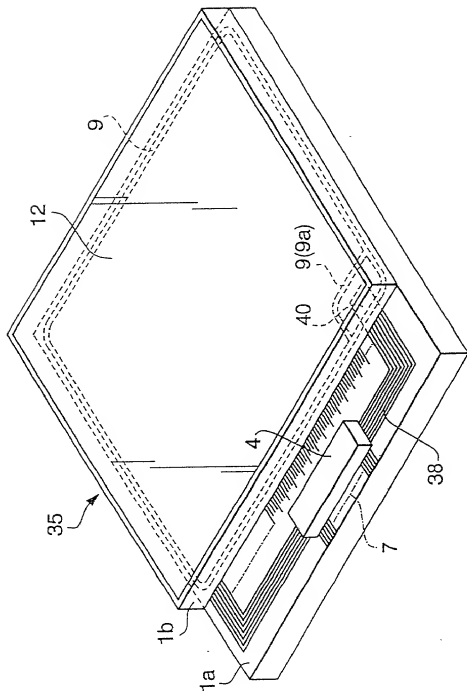


FIG. 11

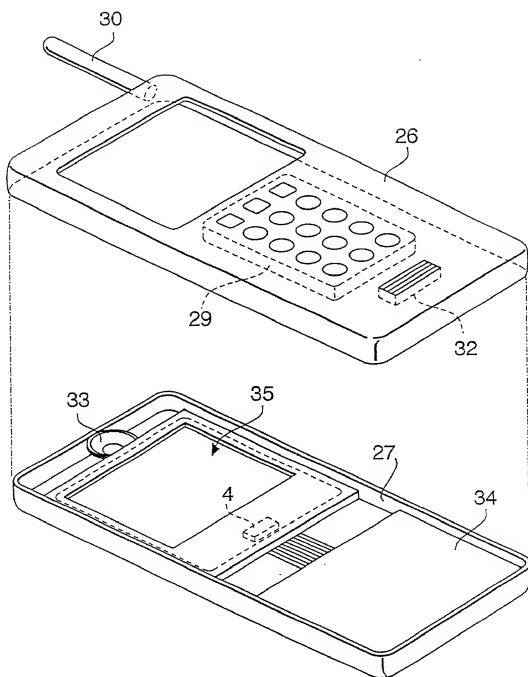
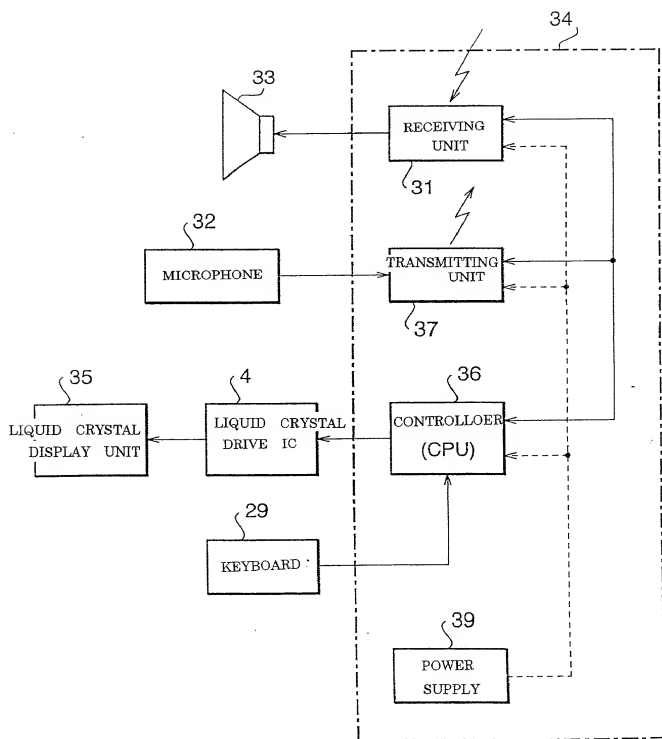


FIG. 12





Under the Paperwork Reduction Act of 1995, no persons are required to respond to collection of information unless it displays a valid OMB control number.

Seiko Epson Ref. No.: FP03235US00

Attorney's Ref. No.: 9319S-000082

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は、下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

液晶表示装置、液晶表示装置の製造方法及び電子機器

LIQUID CRYSTAL DISPLAY DEVICE, METHOD OF MANUFACTURING THE SAME AND ELECTRONIC EQUIPMENT

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

☐ _____ に提出され、米国出願番号または
特許協定条約 国際出願番号を _____ とし、
（該当する場合） _____ に訂正されました。

☐ was filed on _____
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration

(日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国以外の国の少なくとも1ヶ国を指定している特許協力条約365条(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

外国での先行出願

Priority Not Claimed

優先権主張なし

9-103711

Japan

21/April/1997

(Number)

(Country)

(Day/Month/Year Filed)

(番号)

(国名)

(出願年月日)

9-103712

Japan

21/April/1997

(Number)

(Country)

(Day/Month/Year Filed)

(番号)

(国名)

(出願年月日)

私は、第35編米国法典119条(e)項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119 (e) of any United States provisional application(s) listed below.

(Application No.)

(Filing Date)

(Application No.)

(Filing Date)

(出願番号)

(出願日)

(出願番号)

(出願日)

私は下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条(c)に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則第37編1章56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365 (c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application:

PCT/JP98/01804

21/April/1998

Pending

(Application No.)

(Filing Date)

(Status: Patented, Pending, Abandoned)

(出願番号)

(出願日)

(現況: 特許許可済、係属中、放棄済)

(Application No.)

(Filing Date)

(Status: Patented, Pending, Abandoned)

(出願番号)

(出願日)

(現況: 特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私が入手した情報と私の信じることに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行えば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to collection of information unless it displays a valid OMB control number.

Japanese Language Declaration

(日本語宣言書)

委任状： 私は、下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。(弁理士、または代理人の氏名及び登録番号を明記のこと)

G. Gregory Schivley, (Reg. 27,382)
Bryant Wade, (Reg. 40,344)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

2 G. Gregory Schivley, (Reg. 27,382)
Bryant Wade, (Reg. 40,344)

書類送付先:

Harness, Dickey & Pierce, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303

Send Correspondence to:

Harness, Dickey & Pierce, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303

直接電話連絡先: (名前及び電話番号)

Harness, Dickey & Pierce, P.L.C.
(248) 641-1600

Direct Telephone Calls to: (name and telephone number)

Harness, Dickey & Pierce, P.L.C.
(248) 641-1600

唯一または第一発明者名

村松 永至

Full name of sole or first inventor

発明者の署名

村松 永至

日付

1996年12月11日

Inventor's signature

Eiji Muramatsu

Date

December 11, 1996

住所

日本国 長野県 豊科町

Residence

Toyoshinomachi Nagano-ken

Japan X

国籍

日本

Citizenship

Japan

私書箱

392-8502 日本国長野県諏訪市大和3丁目3番5号
セイコーエプソン株式会社内

Post Office Address

c/o Seiko Epson Corporation
3-5, Owa 3-chome, Suwa-shi, Nagano-ken 392-8502 Japan

第二共同発明者

山田 滋敏

Full name of second joint inventor, if any

第二共同発明者の署名

山田 滋敏

日付

1998年12月14日

Second inventor's signature

Shigemasa Yamada

Date

December 14, 1998

住所

日本国 長野県 穂高町

Residence

Hotaka-machi, Nagano-ken

Japan X

国籍

日本

Citizenship

Japan

私書箱

392-8502 日本国長野県諏訪市大和3丁目3番5号
セイコーエプソン株式会社内

Post Office Address

c/o Seiko Epson Corporation
3-5, Owa 3-chome, Suwa-shi, Nagano-ken 392-8502 Japan

(第三以降の共同発明者についても同様に記載し、署名をすること)

(Supply similar information and signature for third and subsequent joint inventors.)

Under the Paperwork Reduction Act of 1995, no persons are required to respond to collection of information unless it displays a valid OMB control number.

Japanese Language Declaration

(日本語宣言書)

委任状： 私は、下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。(弁護士、または代理人の氏名及び登録番号を明記のこと)

G. Gregory Schivley, (Reg. 27,382)
Bryant Wade, (Reg. 40,344)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

G. Gregory Schivley, (Reg. 27,382)
Bryant Wade, (Reg. 40,344)

書類送付先:

Harness, Dickey & Pierce, P.L.C.
P.O. Box 828
Blomfield Hills, Michigan 48303

Send Correspondence to:

Harness, Dickey & Pierce, P.L.C.
P.O. Box 828
Blomfield Hills, Michigan 48303

直接電話連絡先: (名前及び電話番号)
Harness, Dickey & Pierce, P.L.C.
(248) 641-1600

Direct Telephone Calls to: (name and telephone number)
Harness, Dickey & Pierce, P.L.C.
(248) 641-1600

第三共同発明者

池上 稔

Full name of third joint inventor, if any

第三共同発明者の署名

日付

Third inventor's signature

Date

池上 稔

1998年12月21日

Hiroaki Ikegami

December 21, 1998

住所

Residence

日本国

長野県

豊科町

Toyoshima-machi, Nagano-ken, Japan

国籍

Citizenship

日本

Japan

私書箱

Post Office Address

392-8502 日本国長野県諏訪市大和3丁目3番5号
セイコーエプソン株式会社内

c/o Seiko Epson Corporation
3-5, Owa 3-chome, Suwa-shi, Nagano-ken 392-8502 Japan

第四共同発明者

Full name of fourth joint inventor, if any

第四共同発明者の署名

日付

Fourth inventor's signature

Date

住所

Residence

日本国

Japan

国籍

Citizenship

私書箱

Post Office Address

(第五以降の共同発明者についても同様に記載し、署名をすること)

(Supply similar information and signature for fifth and subsequent joint inventors.)